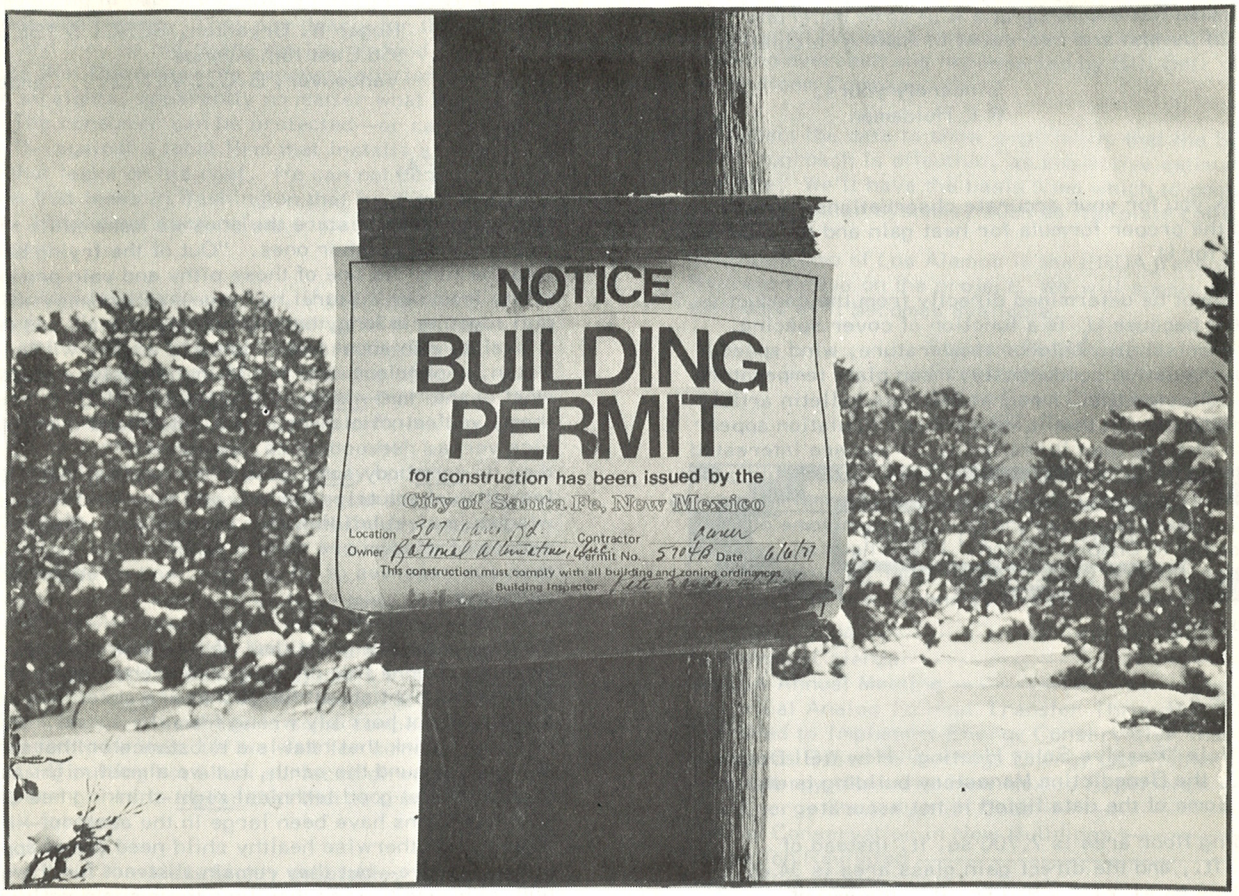
BULLETIN

New Mexico Solar Energy Association



CODES & LEGISLATION:

ARTICLES ON CODES, ENERGY CONSERVATION, AND U-VALUES BY:

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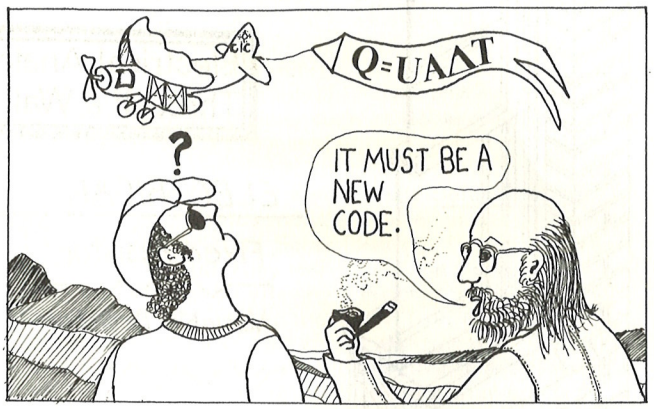
New Energy Conservation Code
by Bristol Stickney

New Mexico has a new Energy Conservation Code which became effective July 1, 1977 and will affect every home builder in the state starting November 1, 1977. On that date, everyone seeking a building permit will be required to submit two sets of plans showing cross sections of all building components (walls, ceilings, floors, etc.) and a complete set of heat loss calculations that indicate compliance with the energy consumption standards outlined in the code. Before we throw our hands up in despair, let us take a closer look at the origin, requirements, and implications of the code.

The 1973 energy embargo inspired the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) to develop an energy conservation standard now identified as ASHRAE 90-75. The purpose of this standard was to provide design requirements to improve the use of energy in new buildings. The reasoning behind ASHRAE 90-75 was a result of long respected "accepted engineering practice" and many states adopted its principles on ASHRAE's reputation alone. California did this in February 1976 and New Mexico followed suit in September 1976. These states really believed that they had the best energy code available until independent researchers like J.L. McGrew began casting doubts upon this foregone conclusion. In fact, using actual measured data and impeccable engineering reasoning, McGrew convinced the California court that a blanket application of ASHRAE 90-75 could actually increase the consumption of energy in some cases. The court prevented enforcement of the code in that state.

Much of the confusion about energy conservation stems from the phrase "accepted engineering practice". This phrase may seem harmless, but it is seething with assumptions. The most blatant assumption in this case was the "steady state U value". A "U" value is a measure of a material's ability to conduct heat. It is related to the heat lost through a building wall by the equation $Q = UA\,\Delta T$ where Q is the heat flow through the wall, A is the area of the wall, ΔT is the temperature difference between the inside surface and the outside surface, and U is the overall conductance of the wall. The same equation is true for roofs, windows, floors, etc. The idea of a steady state U value assumes that the U value is a constant material property that does not change with time. This assumption is valuable for sizing heating and ventilation equipment for the worst possible winter heating load, but it does not reflect the actual daily heat flow through a wall nor does it take into account radiant heat flow through windows (i.e. solar gain) or heat storage capacities of masonry building components. In other words ASHRAE 90-75 treats frame structures and adobe structures, north windows and south windows all to be similar in their thermal performance, which we know is not the case at all.

When the inadequacy of ASHRAE 90-75 was realized in the state of New Mexico, the decision was made not to throw out the code for revision as California had done, but to use the technical content of the code as a skeletal structure on which to base a re-organized code that would truly be energy conservative. At this time a computer study was begun at the New Mexico Energy Institute to develop "effective U values" that would reflect more accurately the average daily thermal response of building components in different areas of New Mexico. These effective U values are defined as the average heat transfer rate per unit area during a specified time period, divided by the average temperature difference during the same time interval. The results of this study astonished the world of "accepted engineering practice" by showing that in some cases a wall actually performed 300-400 per cent differently than the standard ASHRAE steady state U values would indicate. These results are not entirely conclusive but they are incorporated into the present code as an alternative method of thermal analysis to indicate compliance with the code. Oddly enough, south facing windows and dark colored south walls were shown to have a negative effective U value in many parts of the state, indicating a net energy gain rather than a loss through those components. This comes as no surprise to long-standing solar enthusiasts.



The body of the present New Mexico Building Code regulates the following things: The Building Envelope Requirements including the thermal performance of various components and air infiltration rates through windows and doors. The selection of the Mechanical System in terms of equipment efficiency, duct insulation, and control devices for heating, ventilating, and water heating devices. Electrical power and lighting distribution. The Code allows three separate paths by which a builder may demonstrate compliance. The Component Criteria method outlines the use of materials that are acceptable under the prescriptive requirements of the ASHRAE 90-75 code (i.e. the use of plenty of insulation, small windows, and tight-fitting doors). The Systems Analysis method indicates that a building using non-standard materials or alternative non-depletable resources shall be accompanied by an engineering analysis comparing it to a similar building of standard construction showing that it does not exceed the allowable energy consumption of the standard building. The Acceptable Practices method is limited to residential buildings of three stories or less, or small non-residential buildings of wood-frame or masonry-wall construction. This provision allows the use of the results of the effective U value study which outlines acceptable wall types for different climate zones in New Mexico and requires heat loss calculations using standard U values or calculations using "effective U values" accompanied by a "request for variance".

A quick call to the Construction Industries Commission (C.I.C.) revealed that the enforcement of the code is actually fairly uniform regardless of whether a proposed building is going to be solar heated or not. The requirements are the same for all home builders, as outlined in the first paragraph of this article. Solar heated buildings will be given an energy credit which will be applied to their overall heat loss calculations which should make it easier for solar buildings to comply with the energy consumption standards than for non-solar buildings. The biggest stumbling block for home builders is obtaining heat loss calculations. The C.I.C. is willing to accept these calculations from the home builder himself if he or she is capable. The best way to learn how to do these calculations is to borrow a copy of the Energy Conservation Code Applications Manual printed by the New Mexico Energy Institute of the University of New Mexico and read through the examples and worksheets. All that is involved is addition, multiplication and

division. The C.I.C. has offered advice and help to the homebuilder on a limited basis especially to low income builders. For the not-so-low income builder, the option of hiring an engineer to do the calculations is always open.

The code does not eliminate the possibility of alternative design and makes special provision for evaluation of innovations. It does, however, place a heavy burden of proof on the builder which may indirectly discourage innovative building in the state. It also may tend to discriminate against low income or uneducated builders who may have the experience and skill to build for themselves, but are intimidated by the formality of the required plans and calculations. If properly enforced, this code will assure energy efficient design in all new construction, but it could also prove to be a cumbersome roadblock to owner-builders and a low cost housing deterrent. The balance lies in the quantity and the quality of the assistance that the C.I.C. and the state are willing to offer individual builders. In most cases, all that will be needed for a quick education in code compliance is a sample plan, sample calculations, and a list of standards for the builder's climate region. If you are trying to build, and feel that you are up against a road block, contact the NMSEA office in Santa Fe and we will try to supply you with the necessary information for code compliance.

Energy Conservation in New Buildings
by Buck Rogers

90-75 is the basis of most of the current generation of state and municipal "energy codes". As a result it has been kicked around by a lot of highly vocal newcomers to the energy field, persons who are frequently not aware of just where ASHRAE fits into the HVAC profession. ASHRAE is a professional society operating in the area of the environmental sciences. It is dedicated to the advancement of the profession and its allied industries. It does this in part by publishing the Handbook series, and Standards. The Handbook consists of a continuously revised set, consisting of Fundamentals, Systems, Applications, and Equipment; one new revision each year. Standards are developed in committee and are reviewed at least once every five years; more frequently if needed. The monumental task of revising both the Handbook and developing Standards is done entirely by volunteer committee and sub-committee members. To the best of my knowledge only one article in the Handbook series has been partially supported by a grant in aid, that was Chapter 59 of the 1974 Applications volume, "Solar Energy Utilization for Heating and Cooling". So, let's start off by getting the image straight. ASHRAE consists of a bunch of hard working, serious professionals. In the context of 90-75, I would observe that Larry Spielvogel, (a member of the 90-75 committee and Chairman of Panel No. 5 of that committee) published a short article some time ago that pointed out that the energy profile of an institutional building could be increased by blindly making use of too much insulation. A conclusion that I am sure Dr. McGrew would applaud.

I personally have no problem with 90-75 as far as technical matters are concerned. It provides a straightforward means of screening an architect's design to make sure that the esthetics have not gotten out of control at the expense of the integrity of the thermal envelope. Sections 10 and 11 provide adequate give and take to qualify innovative solutions and solar design. The 20,000 sq. ft. exemption of Sect. 11 allows most solar designs to qualify without a lot of expensive computer analysis. However, a professional review is required; and this may present an obstacle to many of the owner-designer/builder efforts.

The problem with 90-75, as far as the general public is concerned, and the solar community in particular, lies in the fact that the Standard is largely a prescriptive document. For conventional construction this presents no problem, you just do things by the book and you get your building permit. For the owner-designer/builder working in the solar idiom there may be enforcement problems. There is a graphic demonstration of the problem to be seen if one sets 90-75 along side the manual that has been prepared as a guide for New Mexico building inspectors in interpreting it. The standard is a scant 3/16" thick, the manual is a big loose-leaf binder pretty well filled with interpretive material. I feel that there is a real need to establish some mechanism that will protect the low income owner-designer/builder in his effort to provide a comfortable dwelling for his family. Many of the solar innovators fall in this category. They have opted for solar as a means of dealing with the crushing cost of fossil fuel, a problem that harshly impacted the poor long before the energy crunch hit the headlines. I have a few thoughts on the matter.

How about a technical analog of Rural Legal Services or the Public Defender. A place where the low income innovator could go for review of his project before dealing with building officials. An office that would assist in developing the project, and also stand ready to represent the owner in any conflicts that might arise as to code or standard problems. The legal profession has dealt with a similar problem in their area, why could not the architectural and engineering profession do likewise. Public funding would be required, but there is a real need for innovative solutions, and a real need for low cost application of a non-depletable resource such as the sun. Seems like a good use of tax money. It might even be a good idea to have a lawyer on the staff.

Another area of interest lies in interpretation of the codes and standards. This problem becomes more acute as one enters into the field of energy technology. Building officials are being confronted with complex technical problems. They are being forced to develop a high level of technical expertese. There is the problem of errors of judgement, errors that may be very costly. It is high time that they, like the design professionals, be held responsible for their errors or omissions and be prepared to bear the costs. In the past many inspectors have had the ultimate defense, they had little in the way of assets and thus were not worth sueing. If professional liability insurance was required of all building officials two ends would be served. The public would have recourse to recover when damaged by the actions of a building inspector. The enforcement entity would be protected from political pressure to hire inadept personnel, as the underwriters would refuse to accept the risk. (Underwriters individually rate each architect or engineer when issuing professional liability policies.)

90-75 was the result of the primary effort of 112 members of the committee set up to develop this standard. They were supported by other standing ASHRAE committees. It is not cast in concrete but is subject to interpretation and revision at any time that technical justification can be offered. It will probably be superseded by a performance standard at a time in the future when a lot of the passive parameters have been nailed down (I think of some of Doug Balcomb's "rules of thumb"). Until that time, I find it a useful document. With intelligent interpretation, and adequate consumer protection it should not inhibit innovative solar architecture.